APPENDIX A

Traffic Information

for

Project 1440-13/15-00
WIS 23 (Fond du Lac - Plymouth)
Fond du Lac and Sheboygan Counties

Summary of Level of Service Computations

Using HCS2000: Two-Lane Highways Release 4.1c

Segment: County K to County UU

Traffic Year and Highway Type	Hourly Traffic Counts	Level of Service	Percent Time Spent Following
2001 – Two Lanes	1250	D	76.4
2030 – Two Lanes	2000	E	88.5
2030 – Four Lanes	2000	B	Not applicable

Segment: County UU to County W

Traffic Year and Highway Type	Hourly Traffic Counts	Level of Service	Percent Time Spent Following
2001 – Two Lanes	850	C	63.6
2030 – Two Lanes	1350	D	76.5
2030 – Four Lanes	2000	A	Not applicable
2030 – Passing Lanes	2000	D	67.2

Segment: County W to County T

Traffic Year and Highway Type	Hourly Traffic Counts	Level of Service	Percent Time Spent Following
2001 – Two Lanes	700	C	59.4
2030 – Two Lanes	1250	D	74.8
2030 – Four Lanes	2000	A	Not applicable
2030 – Passing Lanes	2000	D	70.6

Segment: County T to County P

Traffic Year and Highway Type	Hourly Traffic Counts	Level of Service	Percent Time Spent Following
2001 – Two Lanes	950	C	65.0
2030 – Two Lanes	1500	D	78.8
2030 – Four Lanes	2000	A	Not applicable

Above is a summary of the results from HCS2000 traffic software. Data sheets available upon request.

ORIGINATOR	PROCEDURE
Director, Bureau of Highway Development	11-15-10
CHAPTER 11	Design
SECTION 15	Design Controls
SUBJECT 10	Passing Lanes and Climbing Lanes

PASSING LANES

General

A passing lane is an auxiliary lane constructed along side a two-way, two-lane rural highway to provide the desired frequency of safe passing zones. Passing lanes are particularly advantageous where passing opportunities are limited because of traffic volumes, roadway alignment or a high proportion of slower vehicles. Passing lanes differ from truck climbing lanes in that passing lanes are provided regardless of topography. Truck climbing lanes are provided specifically on hills to allow faster moving traffic an opportunity to pass safely. However, newly constructed truck climbing lanes should meet the same standard entrance/merge taper length, lane width, shoulder width and pavement marking as newly constructed passing lanes. Refer to Truck Climbing Lanes in this procedure for guidance pertaining to truck climbing lanes.

Design criteria were selected from various published studies on the subject of passing lanes which can be used for background information and guidance. Refer to the bibliography at the end of this procedure [1], [2], [3], [4] and [5].

Application Criteria

Use the following criteria to determine if passing lanes are appropriate for the corridor in question.

Access Control

Passing lane areas should be access controlled early in the process to protect the corridor from potential conflicts.

Passing Lane Corridors

Corridor lengths of 15 to 50 miles (**24-80 km**) are appropriate for planning and design purposes. Designers must also consider logical termini and abutting projects, such as Corridors 2020. Some sections of the corridor may not warrant passing lanes at the same time or with the same urgency as others, however the entire corridor should be reviewed as a whole.

See Figure 1 for a state wide map illustrating potential passing lane corridors. This map is based on 20-year traffic projections or for year 2020. Each district has participated in the development of this map and has concurred in the initial location of the passing lane corridors. This map does not identify county trunk highways, however, there may be

situations where the use of passing lanes on a county trunk highway would be appropriate and should be considered.

Location

The general guidelines for selecting appropriate locations for passing lane segments are given below:

1. Passing lanes should be constructed in segments of highway which have a minimal number of entrances and preferably no side roads. For some passing lane segments it may be necessary to include side roads. When selecting a site for a passing lane facility avoid side roads with 500 ADT and over. Driveways and field entrances should be avoided in the merge taper area on either side of the highway. The merge area extends from the W4-2R sign (lane reduction transition) to the end of the taper, or 1,200 feet (**366 m**). See SDD 15 C 8, sheet c. No driveways or intersections should be located closer than 500 feet (**152 m**) from the end of the downstream taper. Designers should consider relocating field entrances and driveways in the merge area. A commercial driveway may be more problematic than a side road, depending on peak hour usage and traffic mix.
2. A widened segment of roadway, with protected left turn lanes, may be constructed in a passing lane section to provide for the left turning traffic when left turn volumes are significant. See Procedures 11-25-5 and 11-25-10 for more detailed information on turn lanes. In those limited areas where 4-lane undivided passing lane sections are required, crossing intersections are not permitted and tee intersections are not desirable.
3. If the comparative cost for construction of passing lanes in rolling and level terrain is nearly the same, it may be desirable to construct them in the rolling terrain at locations where passing sight distance is unavailable, leaving flat sections for normal passing during the off peak periods. Avoid passing lanes on horizontal curves greater than 3 degrees, if possible.

Traffic Volumes

Determine the current and design year (projected 20 year) Average Annual Daily Traffic (AADT) and two-way Design Hour Volume (DHV). Use the 100th highest hour (K100) when determining the DHV. On most rural two-way highways the DHV ranges from 10% to 15% of the AADT. Recreational routes, however, can have a significantly higher percentage of traffic in the DHV. Districts should consult with their Systems Planning and Operations section to get site specific hourly counts for recreational routes (including weekends) in order to gain a more realistic understanding of the situation.

To obtain traffic projections submit a TRAFFIC FORECAST REQUEST (Procedure 3-10-10, Figure 1) to DTIM Traffic Forecasting, HFSTB Room 901.

Generally, if the 20-year traffic projections exceed 12,000 AADT or exceed 1,400 two-way DHV it may be appropriate to consider expanding the facility to 4-lanes. The district will consider the priority and funding of all projects, then determine whether passing lanes or other treatment is most appropriate.

When the 20-year projected, two-way DHV falls between 200 and 1,400 use the nomograph provided in Figure 2 and the DHV from the Traffic Forecast to see if passing lanes should be considered further. Note, this nomograph is from the Washington State DOT design manual so “rolling” implies a high degree of elevation variation.

Higher priority highways will generally have design year AADT $\geq$ 3,500 and <12,000; two-way DHV greater than 400 and less than 1,400; passing opportunity less than 61%; trucks and RV’s greater than 4%.

Design Criteria

Lane Width and Shoulder Width

1. Passing lane width is normally 12 ft. **(3.6 m)** for new construction, reconstruction and 3R projects.
2. Shoulders should be full width, similar to the adjacent two-lane highway section, for the classification and ADT of the facility. Shoulders should be paved similar to the adjacent two-lane facility.

Designers may consider providing less than standard shoulder width in certain areas where excessive cuts and fills would substantially increase the construction cost. In such cases the designer must request an exception to design standards as specified in Procedure 11-1-2.

3. Minimize the occurrence of 4-lane sections of undivided highways (overlapping passing lane areas).
4. It is important, where possible, to provide advancing traffic with the experience of the passing lane prior to seeing it in the opposing lane.

Clear Zone

The clear zone on newly constructed passing lane sections, independent of project type, shall be computed from the outer most lane, outside edge of traveled way.

On new construction and reconstruction projects the clear zone shall meet new construction standards per Procedure 11-15-1. On reconditioning projects the desirable clear zone adjacent to new passing lanes is the new construction standard per Procedure 11-15-1. The minimum clear zone on reconditioning projects is the greater of the AS Built clear zone distance from previous construction or the 3R clear zone requirement in Procedure 11-40-1. Justification for not meeting/exceeding the desirable new construction standard shall be stated in the DSR. Resurfacing and pavement replacement projects will typically not include the construction of new passing lanes.

For existing passing lanes on 3R projects refer to Procedure 11-40-1.

Passing Lane Length

The optimal passing lane length, excluding tapers, is provided in the following table and is based on design year two-way Design Hour Volume (DHV).

Two-Way Total DHV	Length of Passing LaneMiles **(km)**
Less than 600	.50 - 1 **(0.8-1.6)**
600 - 1,000	.75 - 1.50 **(1.2-2.4)**
1,000 - 1,400	1 - 2 **(1.6-3.2)**

Spacing Between Passing Lane Sections

Provide 3-8 mi (**5-13 km**) spacing between passing lanes in the same direction of traffic. This spacing depends on traffic volumes and passing opportunities outside of the actual passing lane location. The spacing must be flexible to permit selection of suitable and inexpensive passing lane locations.

Taper Lengths, Locations and Signal Location

1. Passing lane approach and merge taper lengths should be 700 feet (**213 m**).
2. Passing lanes should be designed with good visibility at the end of merge taper. Do not end a merge taper at or near the crest of a hill. The end of the taper should be physically visible from the W4-2R sign (lane reduction transition).

3. Access is undesirable on either side of the highway in merge taper areas. Do not end merge tapers immediately prior to an intersection. Provide a minimum of 500 feet (**152 m**) of space down stream from the end of the taper to the nearest access point.
4. Signals down stream from passing lanes should be at least 1 mile (**1.6 km**) from the closest merging taper end.
5. A merge taper shoulder may include rumble strips and/or raised pavement markers.

Signing and Pavement Marking

Drivers may not know if the extra lane they encounter is a passing lane or a truck climbing lane. For driver expectancy and design consistency similar standards should apply where practical. See Standard Detail Drawing 15C8, sheet 'c' for pavement marking and signing information.

Pavement Marking

1. Provide diagonal skip-dash pavement marking at the entrance taper to guide traffic to the right when the shoulder width and construction is the same as the adjacent two-lane facility. Do not install the skip-dash pavement marking when the shoulder width is less than standard for the facility.
2. Allow passing by opposing lane traffic if passing sight distance is available. This is allowed in accordance with the MUTCD [6] and Highway Capacity Manual [7]. Studies have found no adverse problems with this procedure. Districts should consider side roads, commercial driveways or other situations when it may be desirable to provide a double yellow at the center line.

CLIMBING LANES

Application Criteria

Climbing lanes should be provided to assure a uniform level of service rather than as a necessity to avoid extreme congestion and disruption of traffic flow. A climbing lane is warranted when the upgrade is so steep and long that loaded trucks experience a speed reduction of ten mph or more and when the DHV exceeds the level of service 'D' (5.00). Other factors to consider, on the upgrade, are the amount and location of left or right turns at intersections or driveways within the segment. Refer to GDHS, pages 227-262, for guidance in determining the length of need for climbing lanes.

Design Criteria

Lane width and shoulder width

1. Climbing lane width is normally 12 ft. **(3.6 m)** independent of project type.
2. Newly constructed climbing lanes should include full width shoulders for the classification and ADT of the facility. This is independent of project type. Shoulders should be paved similar to the adjacent two-lane facility. When beam guard is present it may be desirable to extend the paved shoulder to the post location.
3. Designers may consider providing less than standard shoulder width in certain areas where excessive cuts and fills would substantially increase the construction cost. In such cases the designer must request an exception to design standards as specified in Procedure 11-1-2.
4. For existing climbing lane shoulders on 3R projects refer to Procedure 11-40-1.

Clear Zone

The clear zone on new climbing lane sections, independent of project type, shall be computed from the outer most lane, outside edge of traveled way.

On new construction and reconstruction projects the clear zone shall meet new construction standards per Procedure 11-15-1. On reconditioning projects the desirable clear zone adjacent to new climbing lanes is the new construction standard per Procedure 11-15-1. The minimum clear zone on reconditioning projects is the greater of the AS Built clear zone distance from previous construction or the 3R clear zone requirement in Procedure 11-40-1. Justification for not meeting/exceeding the desirable new construction standard shall be stated in the DSR. Resurfacing and pavement replacement projects will typically not include the construction of new climbing lanes.

For existing climbing lanes on 3R projects refer to Procedure 11-40-1.

Taper Lengths and Locations

1. Climbing lane approach and merge taper lengths should be 700 feet **(213 m).**
2. Climbing lane merge tapers should be physically visible from the W4-2R sign (lane reduction transition). The climbing lane should be carried well beyond the crest to a point where trucks are able to regain a speed within 10 mph **(15 km/h)** of the speed of other vehicles.
3. Access is undesirable on either side of the highway in merge taper areas. Do not end merge tapers immediately prior to an intersection. Provide a minimum of 500 feet **(152 m)** of space down stream from the end of the taper to the nearest access point.

Signing and Pavement Marking

Drivers may not know if the extra lane they encounter is a passing lane or a truck climbing lane. For driver expectancy and design consistency similar standards should apply where practical. See Standard Detail Drawing 15C8, sheet 'c' for pavement marking and signing information.

Pavement marking:

1. Provide diagonal skip-dash pavement marking at the entrance taper to guide traffic to the right when the shoulder width is the same as the adjacent two-lane facility. Do not install the skip-dash pavement marking when the shoulder width is less than standard for the facility.
2. Allow passing by opposing lane traffic if passing sight distance is available [6,7]. Studies have found no adverse problems with this procedure. Districts should consider side roads, commercial driveways or other situations when it may be desirable to provided a double yellow at the center line.

Bibliography

[1] "Low-Cost Methods For Improving Traffic Operations On Two-Lane Roads" by D. W. Harwood and C. J. Hoban, January 1987;
[2] Transportation Research Record (TRR) 1303 "Warrants For Passing Lanes" and "Traffic Performance and Design of Passing Lanes";
[3] TRR 1512 " Relationship Between Operational and Safety Considerations in Geometric Design Improvements";
[4] TRR 1628 "Drivers' Attitudes, Understanding, and Acceptance of Passing Lanes in Kansas";
[5] Ministry of Transportation, Ontario, Canada, "Operational Safety Review of Passing Lane Sites".
[6] Manual on Uniform Traffic Control Devices, 1988 Edition
[7] Highway Capacity Manual, Special Report 209, 1999 Edition

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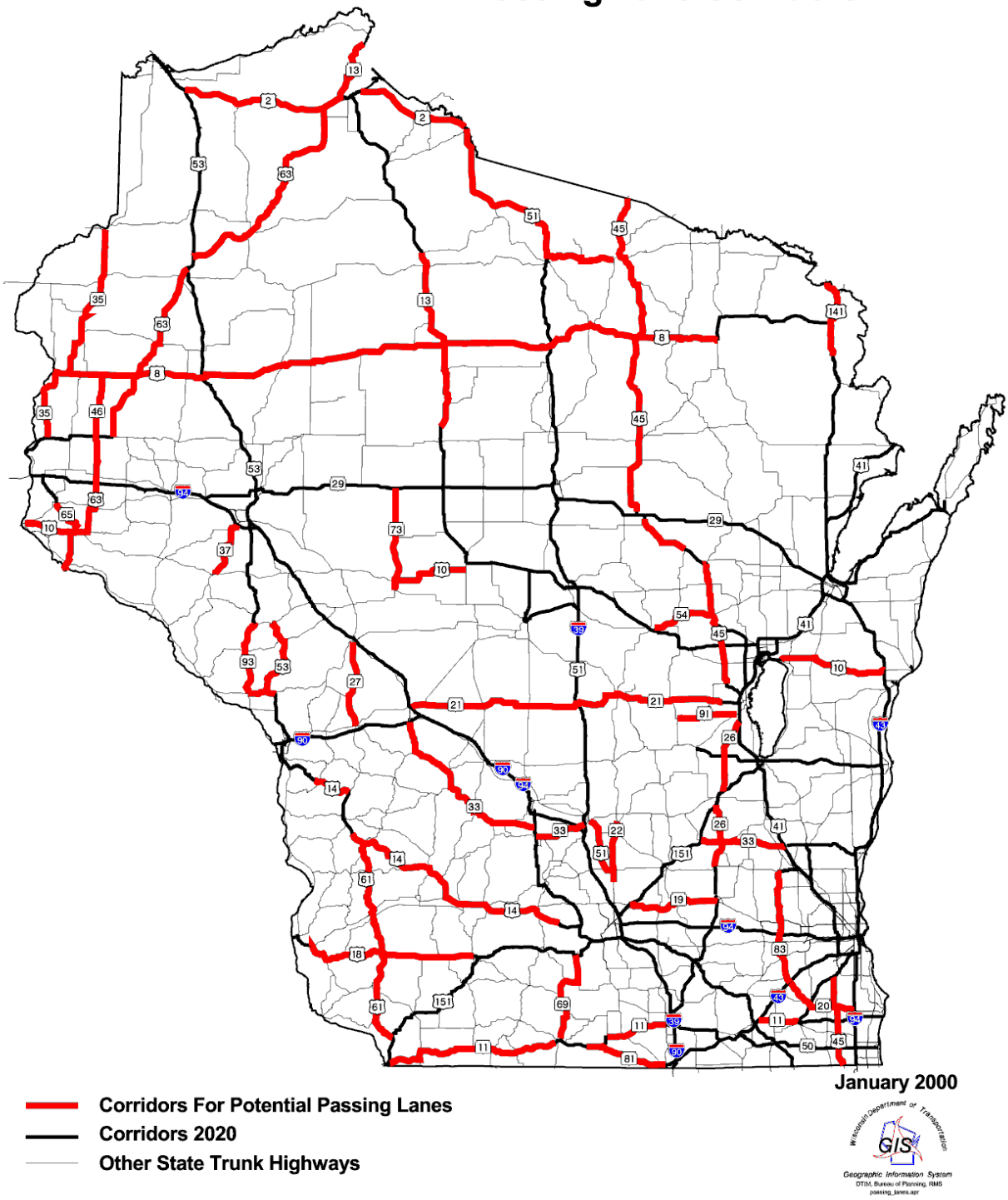
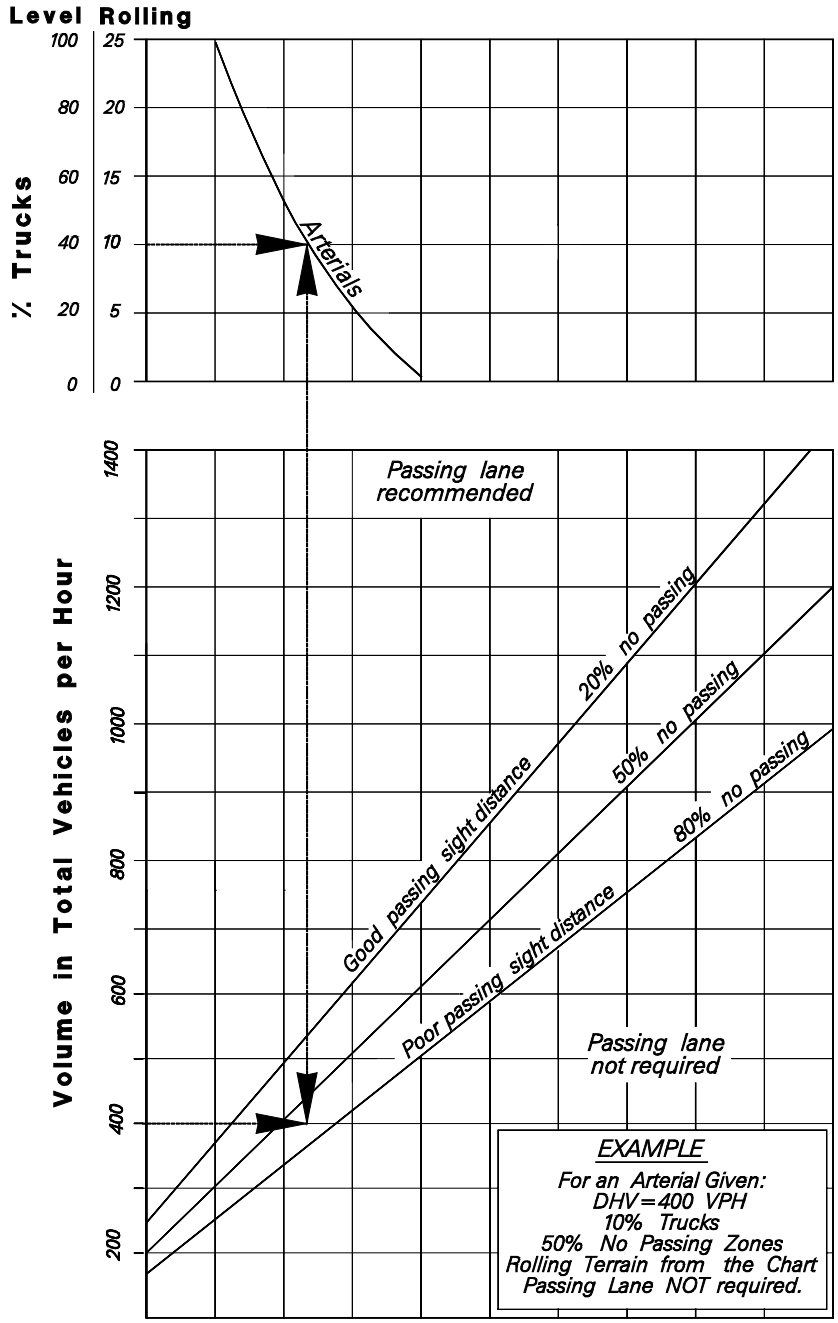
Wisconsin Rural State Trunk Highway Passing Lane Corridors



Warrant for Considering Passing Lanes



Note: The Rolling Terrain criterion should be considered only for projects located in western and southwest Wisconsin. See the text of this procedure for additional warranting criteria.

Source: Washington State DOT